

a silicon-containing functional group combining with a hydroxyl group present on the treated surface by dehydration or dehydrogenation.

The invention also provides a method of stain resistant treatment applied to a ceramic product used with water and having a treated surface on which a layer comprising a stain resistant agent is formed so that a stain resistant treatment is applied to the ceramic product, the stain resistant agent including a silicon-containing functional group combining with a hydroxyl group present on the treated surface by dehydration or dehydrogenation.

In the present invention, the stain resistant agent contains the silicon-containing functional group (X-Si-O-) which combines by the dehydration or dehydrogenation with the hydroxyl group (-OH) present on the treated surface such as a glazed surface, thereby shielding the hydroxyl group. Accordingly, even when used water contains a large quantity of metal ion such as soluble silica, the hydroxyl group is already disabled or ineffective such that the hydroxyl group does not combine with any metal ion and accordingly with any component of human waste etc. Particularly even when used water contains soluble silica as the metal ion, the soluble silica is not deposited or is not apt to be deposited as silicic acid with network structure such that stain is not apt to be incorporated. Thus, if the stain resistant agent has the silicon-containing functional group, stain such as human waste is prevented from adhering to the ceramic product even when the ceramic product is used with water containing a large quantity of metal ion such as soluble silica, whereupon

the ceramic product can easily be cleaned.

The silicon-containing functional group does not preferably combine with another silicon-containing functional group. According to the results of experiments conducted by the inventors, high scale, hairdye, wear and alkali resistances can be achieved. If the silicon-containing functional groups of the stain resistant agent combine with each other, silica is increased such that silicic acid with the network structure is deposited on the layer. Stain can be considered to be incorporated with the silicic acid.

Additionally, the silicon-containing functional group of the stain resistant agent has a durability as high as silica in the glazed surface of the ceramic product.

The stain resistant agent preferably contains a terminal carbon fluoride group combining with the silicon-containing functional group. Results of experiments conducted by the inventors show that the stain resistance also appears as water repellency by a small critical surface tension of the carbon fluoride group. Consequently, high scale, hairdye, wear and alkali resistances can be achieved.

The carbon fluoride group is preferably  $-C_nF_{2n+1}$  where  $n$  is a natural number in a range of  $1 \leq n \leq 12$ . Results of experiments conducted by the inventors show that this increases fluoride and accordingly fluorosilane. Consequently, high scale, hairdye, wear and alkali resistances can be achieved.

The stain resistant agent preferably contains a terminal alkyl group combining with the silicon-containing functional group. Results of experiments conducted by the inventors show that the stain resistance also appears as lipstick stain and alkali

resistances by a small critical surface tension of the alkyl group.

The stain resistant agent does not preferably contain any terminal alkali group combining with the silicon-containing functional group. Results of experiments conducted by the  
5 inventors show that this can achieve large scale, hair dye, wear and alkali resistances.

From the viewpoint of the wear resistance, a methyl group may be employed as the alkyl group. On the other hand, a propyl or hexyl group may be employed as the alkyl group from the viewpoint  
10 of alkali. Results of experiments conducted by the inventors show that when the alkyl group is a propyl or hexyl group, the alkyl group is increased. The stain resistant agent is advantageous in the alkali resistance but disadvantageous in the wear resistance. On the other hand, when the alkyl group is a  
15 methyl group, the stain resistant agent is advantageous in the wear resistance but disadvantageous in the alkali resistance.

A quantity of the alkyl group is preferably larger than a quantity of the carbon fluoride group when the stain resistant agent contains a terminal carbon fluoride group combining with  
20 the silicon-containing functional group and a terminal alkyl group combining with said silicon-containing functional group. Results of experiments conducted by the inventors show that the stain resistant agent does not contain only perfluoroalkylsilane. Consequently, the stain resistant agent has high lipstick stain  
25 and wear resistances.

On the other hand, a quantity of the carbon fluoride group is preferably larger than a quantity of the alkyl group when the stain resistant agent contains a terminal carbon fluoride group